Project Introduction

The innovation proposed is a framework for autonomous Traffic Flow Management (TFM) under Trajectory Based Operations (TBO) for Unmanned Aerial Systems (UAS). The concept, called DRIFT-UAS (Distributed Resilient Framework for Trajectory Management of Unmanned Aerial Systems), is a cloud-based system that consists of algorithms and an information-sharing framework that would enable autonomous trajectory planning and strategic deconflicting of trajectories of manned and unmanned aircraft, while optimizing system-wide objectives such as safety, efficiency, and equity. DRIFT-UAS envisions four information signals that are exchanged in a cloud-based environment. The signals are (a) trajectory intent from an aircraft to DRIFT-UAS, (b) trajectory feedback (e.g., level of congestion on the proposed route as well as nearby routes in time and space) from DRIFT-UAS to the aircraft (c) loading projections from DRIFT-UAS to NAS ATC resources, and (d) capacity signals derived from weather forecasts, dynamic airspace restrictions, or acceptable loading levels at various NAS resources. The signals are processed by a centralized MDM (Master De-conflicting Module) to generate a trajectory feedback signal, and ATGMs (Autonomous Trajectory Generation Modules) autonomously generate trajectories for aircraft based on the feedback signal. DRIFT-UAS is based on a new class of algorithms for solving large-scale TFM problems by separating TFM optimization into two problems--- a master problem, equivalent to the MDM that checks for capacity violations and allocates resources to competing aircraft, and a sub-problem, equivalent to the ATGM solved by each individual aircraft that generates 4-d trajectories for each flight. The master problem exchanges dual prices that signal congestion across ATC resources to guide the sub-problems to an optimal solution.
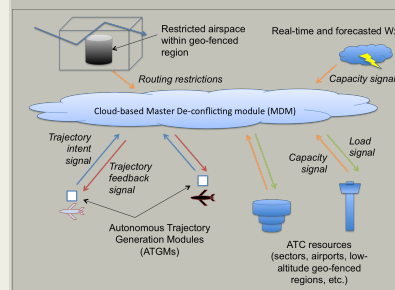
A Framework for Autonomous Trajectory-Based Operations, Phase I
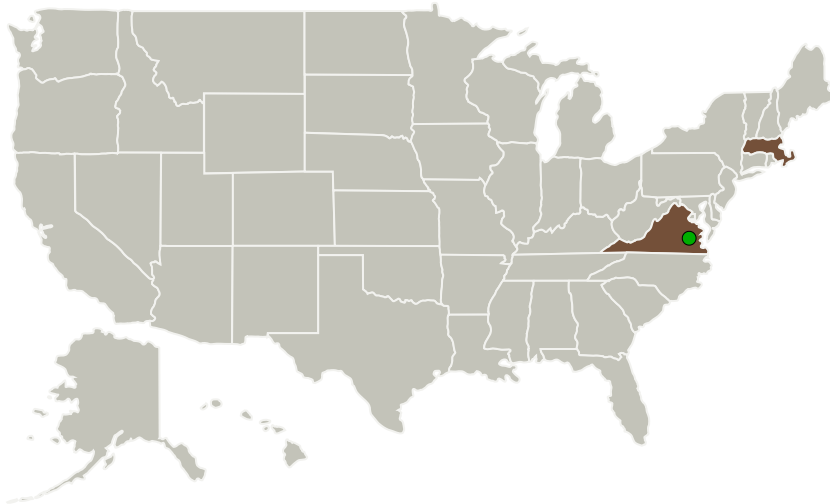
Table of Contents

Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
Resilient Ops, Inc	Lead Organization	Industry	Winchester, Massachusetts
⬤ Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Massachusetts	Virginia

Project Transitions

▶ **June 2015:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Resilient Ops, Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

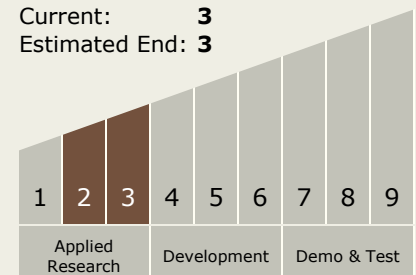Jason L Kessler

Program Manager:
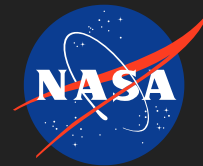
Carlos Torrez

Principal Investigator:

Bala G Chandran

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**

1	2	3	4	5	6	7	8	9
Applied Research			Development			Demo & Test		

TechPort

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For more information and an accessible alternative, please visit:
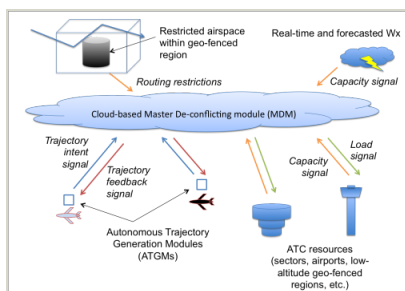https://techport.nasa.gov/view/33914

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✔ **December 2015:** Closed out

Closeout Summary: A Framework for Autonomous Trajectory-Based Operations, Phase I Project Image

Closeout Documentation:
- Final Summary Chart Image*(https://techport.nasa.gov/file/138724)*

Images

Briefing Chart Image
A Framework for Autonomous Trajectory-Based Operations, Phase I
(https://techport.nasa.gov/image/125808)

Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  └ TX17.2 Navigation Technologies
    └ TX17.2.3 Navigation Sensors

Target Destinations
The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System